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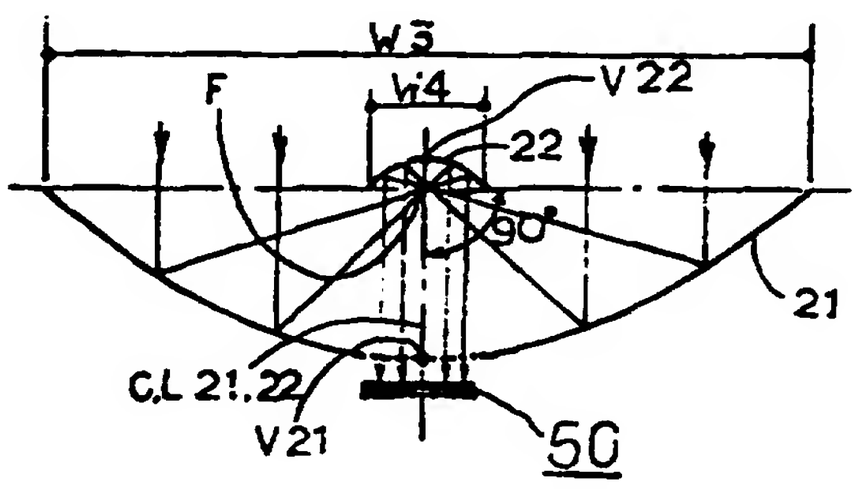
(57) Abstract

A concentrating optical system in which semi-parabolic type mirrors being spread to one side are constructed for use with primary concentrating and secondary concentrating, or a concentrating system for concentrating in parallel a large and small parabolic type mirrors (21, 22) confronting each other is constructed, so that the parallel concentrated light is heat collected, light collected or utilized for lighting, or else a refractive type converging concentrator is constructed whereby concentrating at high concentrating ratio. Since a light of wide range from not only high density but up to low density is tracked and concentrated, not only a solar furnace (50) but even telescope also are newly developed. A wide range concentrated light utilizing device is made in which not only natural light such as sun light and star light but also the light produced from artificial light source can be concentrated whereby utilized to industry.



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CONCENTRATING OPTICAL SYSTEM AND CONCENTRATED LIGHT UTILIZING APPARATUS

TECHNICAL FIELD

The present invention relates to a concentrating optical system and concentrated light utilizing apparatus which is very wide in concentrating ratio selecting width for concentrating in parallel or converging and concentrating a natural light including sun light or an artificial light to any concentrating ratio and for utilizing the concentrated light to an object. There is method for utilizing a sun light among natural light by converting to heat or electric energy or to lighting without converting, and the natural light and artificial light of day or night is utilized for a light source for observation of telescope and the like, and the invention includes a method for constructing a mirror related to a concentrating system aiming them and an apparatus for executing them as constructing elements.

BACKGROUND ART

FIG.1(A),(B) and (C) are already known typical concentrating optical systems being widely used for concentrating a light which is a kind of

electromagnetic wave, and their executing types are variously developed.

According to the concentrating optical system utilizing a reflector of FIG.1(A) and (B), a convergent concentration is easy but not only parallel concentration was difficult but also a light path change of the concentrated light was difficult, while according to a refractive device of FIG.(C), it has had disadvantages that a convergent concentration or parallel concentration was easy but much manufacturing cost was required as much as making to larger, and the light of wide area could not be concentrated due to problem of preciseness.

DISCLOSURE OF INVENTION

The present invention is invented to solve above disadvantages, and which is easy in constructing a solar tracking device or telescope driving device and capable of constructing a device having multiple usages.

As a device utilizing and concentrating a solar radiation energy, there were many devices other than Korean Patent "Solar light concentrating device" (Publication No.85-1135, 9th August '85) and U.S.Patent " Solar Energy Conversion system" (U.S.P.No.4,286,531, 1st September '81), but they were

not widely utilized.

The concentrating optical system of the present invention has not only various characteristics of an applying device construction since the concentrating ratio selection is easy and its constructing width is wide and also a light path change of the concentrated light is easy, but also a parallel or a convergent concentration is both possible.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG.1(A),(B) and (C) are cross sectional views illustrating known concentrating optical system respectively,

FIG.2(A),(B) and (C) are cross sectional views for illustrating a concentrating state in a concentrating optical system of the present invention,

FIG.3(A),(B) and (C) are cross sectional views of executed state in the concentrated light utilizing apparatus of the present invention respectively,

FIG.4(A) and (B) are a perspective view and a cross sectional view for explaining an operating state of a solar tracking devices respectively,

FIG.5 and FIG.6 are cross sectional views taken along central axis line of the concentrated light utilizing apparatus constructed by circular shape and having multiple using functions respectively,

FIG.7 is a perspective view of rotary type light path changer in FIG.5 and FIG.6,

FIG.8 is a partly cut out perspective view showing cross section of a vacuum insulation cavity type concentrating thermal collector in FIG.6,

FIG.9 is a cross sectional view taken along central axis line showing other embodiment of the vacuum insulation cavity type concentrating thermal collector,

FIG.10 is a cross sectional view of a concentrated light utilizing apparatus executed for a solar furnace and a telescope,

FIG.11 is a fragmentary magnified cross sectional view of essential part of a linearly constructed concentration electric generating apparatus of a state viewed from X-X line of FIG.4(B), and

FIG.12 is a fragmentary magnified cross sectional view of essential part of a linearly constructed focus concentration thermal collector of a state viewed from X-X line of FIG.4(B).

EXPLANATION FOR ESSENTIAL PARTS OF DRAWINGS

23 : Thermal collecting tube peripheral bent type mirror

28 : Light passing means

30 : Gear

31 : Bearing

32 : Motor

33 : Key

34 : Support and frame member

36 : Bolt

38 : Actuator

39 : Guide roller

40 : Boss

41 : Set screw

42 : Foundation

43 : Stair

44 : Bearing sleeve

65 : Tube for vacuum-making

66 : Thermo-keeping material

68 : Insulation ring

69 : Coil spring type spacer

75 : Tray for optical cable

83 : Air path for cooling solar cell back surface

102 : Fire brick

F.J : Flange connection

S.J : Screw connection

W.J : Welding junction

V : Vertex

C.L : Axis line

F : Focal point

W.S : Winter solstice

S.S : Summer solstice

W.F : Working fluid

V.Z : Vacuum zone

BEST MODE FOR CARRYING OUT THE INVENTION

Hereinafter, the preferred embodiments of the present invention will be described more in detail with reference to the accompanying drawings.

A concentrating optical system having a cross section in which a semi-parabolic type primary mirror 11 (a light receiving mirror) being spread only to one

side of central axis line C.L. and a constricted analogous figure semi-parabolic type mirror 12 co-owning a focus F of the primary mirror 11 and extending axis lines (C.L. 11, 12) are corresponded as a second mirror 12 (a concentrating mirror) in FIG.2(A), is constructed to a right-left symmetrical linear type as in FIG 3(A) and FIG.4(B), which is a concentrating optical system for concentrating parallel incident light in parallel and having a characteristic that the incident light and the concentrated light paths advance to same direction, and FIG.2(A) is made by a spreading rim angle of 100 degrees and FIG.3(C) is less than 90 degrees, FIG.3(A) shows a right-left symmetrical type cross sectional construction by a 90 degree spreading rim angle, and FIG.4(B) shows that which is constructed by a linear type, and a concentrating ratio is calculated by a spreading width ratio (or distance ratio of focus and vertex) of primary and secondary mirrors 11, 12, which is denoted by W1/W2, and a light utilizing target device 50 is provided on a parallel concentrating light path.

FIG.2(B) and FIG.3(B) show the concentrating optical system of cross sectional structure constructed with parabolic type primary mirror 11 being spread in rim angle of less than 90 degrees and a secondary mirror 12 co-owning a focus F and mutually

crossing in orthogonal with center axis lines C.L.11 and C.L.12, and one which have a characteristic that incident light and concentrating light are crossing and being constructed in right-left symmetrical linear type is shown in cross section in FIG.3(B).

The concentrating ratio is calculated by a spreading width W1/W2 of the primary and secondary mirrors, and the light utilizing target device [reference numeral 50 of FIG.2(B)] does not disturb the reflected light of the primary mirror because it is provided after an opening end of the primary mirror.

The concentrating optical system of FIG.2(C) constructs a concentrating optical system of cross section which co-owns a focus F and center axis line C.L. and confronting analogous figures large and small parabolic type mirrors symmetrically spread based on the central axis line C.L. with rim angle of less than 90 degrees as a primary mirror 21 and a secondary mirror 22 (for concentrating), and which is a concentrating optical system constructed by linear type in which a projecting surface of the secondary mirror 22 is opened at central portion of the primary mirror 21 and a light utilizing target device 50 is provided at a concentrated light path after the opening portion, and its concentrating ratio on cross section is calculated by (W3-W4)/W4, and the light

utilizing target device is provided on the light path after a vertex V21 so as not to disturb the reflected light at the primary mirror 21.

"V"s shown in FIG.2(A),(B) and (C) show a vertex of parabolic type mirrors, and the primary and secondary mirrors may be constructed by a linear type in accordance with using object of a device which receives the concentrated light and utilizes thereof, and the concentrating optical system may be constructed by a parabolic dish type as in FIG.4(A), FIG.5, FIG.6 and FIG.10.

The concentrating optical system described until now has a characteristic of concentrating in parallel the parallel incident light, and when a flat plate type mirrors 26, 27 are slantly provided within a concentrated light path as in FIG.3(C), FIG.5 or FIG.6, the concentrated light path is changed to any inclined direction.

Explaining the target device receiving and utilizing the parallel concentrated light of the concentrating optical system described above; the parallel light can be directly utilized in accordance with characteristic of the target device or can also be re-concentrated and utilized, and for the re-concentrating device construction applied in common to the utilizing device; in FIG.3(A) and (C), FIG.5, FIG.6, FIG.10, FIG.11 and FIG.12, when a linear lens

25 is provided in a concentrating optical system linearly constructed on the parallel concentrated light path and when a circular lens 24 is provided in an article that is constructed in circular type, it is converged and concentrated in focus line shape or focus point shape.

FIG.3(B), FIG.5, FIG.6 and FIG.12 show a thermal collecting device 60 which applies sun light as a light source and provided with a tracking device and mainly produces energy by providing a thermal collector on the concentrated light path.

FIG.3(B) is a case for thermal collecting by a thermal collecting tube 61 constructed by a spherical surface mirror at behind, and FIG.(C) is by an evacuated tube 63.

FIG.12 is a device in which the concentrating system is constructed by a linear structure and the converged concentrated light is thermal collected in cavity by an evacuated tube 63, and which is a cavity type thermal collecting method which constructs a periphery of the evacuated tube 63 except the converged light path or focus line of the linear lens 25 to an inwardly directing mirror 64, and thereby utilizing a mirror that an incident light is not leaked out to exterior.

A right side thermal collecting device 60 of FIG.6, FIG.8 and FIG.9 show a cavity type thermal

collecting device 60 in which in a case that concentrating optical system is made in circular form and a circular lens 24 is provided, a heat-resistant light passing window 62 is provided within a converged and advancing light path, a working fluid thermal collecting tube having " ☐ "-shaped cavity thermal collecting wall 67 receiving a converged light is made, a vacuum insulation layer V.Z is formed to its behind, and a working fluid pipe line is made.

FIG.11 shows a light electric generating device 80 in which a solar cell module 81 is provided to a parallel concentrated light path of linearly made concentrating optical system, a cooling fluid path conduit pipe 82 is made, a tracking device is provided and thereby tracking a solar light and concentrating and generating an electricity, and a cooling pipe 82 is made of rectangular pipe.

Explaining what a lighting device 70 is made in FIG.3(A), FIG.5 and FIG.6 for the concentrating optical system of linear or circular structure provided with a parallel concentrated light converging lens : it is a lighting device 70 in which a light transferring media (light conducting cable and light conductor) receiving the parallel concentrated light or a converged and concentrated light is made to be placed at an end so that the converged light or concentrated light is transferred to a remote

utilizing place such as underground room.

The device of FIG.3(A) is a linear lighting device 70 provided with a tray 75 for an optical fiber cable 71, a right side device of FIG.5 is a circular lighting device 70 provided with single light path 72, a left side device of FIG.6 is a circular lighting device 70 collectively provided with a number of optical fiber cables 71 in bundle state, and which is a light collecting and transferring equipment which should be necessarily made by 2-axes tracking device.

Although the sun light collecting and utilizing device and the like described until now was that of concentrating and utilizing only directly reaching sun beam radiation, a diffused sun light radiation may be existed even on clear weather due to public pollution or moisture in atmosphere, and FIG.3(C) and FIG.11 respectively show that a device is attached which light-generates by a diffusing light and the like being slantly incident by providing a solar cell module 81 at one part region of the central axis line C.L below focus F from vertex V of primary mirror 11 of sun light collecting and utilizing device made by the concentrating optical system and device in linear structure, and a slant incident diffusing light is denoted by dotted line light, and which is particularly suitable for a case that the mirrors 11, 12 are made by semi-parabolic type.

The sun beam can be concentrated by high concentrating ratio since it is concentrated in parallel by the mirrors 11, 12, 21, 22 and the parallel concentrated light is re-concentrated and converged by a converging refractive type concentrator 24, and FIG.10 shows a sun tracking device provided with 2-axes tracking device by a solar furnace 100 melting a material by a focused concentrated light by providing a material melting pot 101 at a converged light focus (converged point).

The left side device 90 of FIG.2 and a device 90 on extended center line of FIG.10 is a concentrated light utilizing device in which an eye lens 24 having same focus as a converging lens is made so as to have a telescopic function, in a case that a circular structure concentrating system is made and a converging circular lens 24 is provided.

A capacity of telescope is further improved because much light is concentrated by wide light receiving area than known telescope made only by refractive lens.

FIG.4 shows an operating characteristic of a tracking device of a device and the like concentrating and utilizing a sun light, which is a view showing a state that which is provided between north and south and 2-axes tracking, and a solar cell module 81 is provided to a primary mirror periphery of the circular

structure device of FIG.4(A), to the primary mirror periphery of linear structural device of FIG.4(B), or to the secondary mirror behind portion of the linear structure device of FIG.4(B), whereby executes proper object function and simultaneously light-generates by peripheral light being not concentrated.

Since the sun is tracked, a generating efficiency is higher than a fixed type light generating device, and generated electric power is charged whereby used for the tracking power or various usage.

FIG.5 and FIG.6 show a concentrated light utilizing device having multiple functions selectively utilizing a concentrated light path by making by dividing the parallel concentrated light path, providing different concentrated light utilizing target devices to both sides divided light paths, providing by attaching a flat plate mirror 27 into a rotationally supporting annular structure receiving tube at the dividing point, and providing a rotary type light path changing device protruded and formed with rotatably operating handle 37, in a case that the concentrating optical system mirrors 11, 12, 21, 22 are made by circular structure.

FIG.5 is a view structured by a telescope 90 and a lighting device 70, and FIG.6 is a view structured by a lighting device 70 and a cavity type thermal collecting device 60, and the sun light during day

time can be selectively utilized for light collection or thermal collection, and which is a device made with telescope function which utilizes the sun light to energy in day time and doing remote observation in night time, and FIG.6 show that a tracking hollow shaft 29 is made by a divided light path and different target devices are divided and provided to both sides.

INDUSTRIAL APPLICABILITY

In accordance with the present invention constructed as above, since the aiming concentrating ratio can be freely selected and designed at primary and secondary mirrors spreading width ratio, a device being various in use can be constructed since primarily concentrated light is converged and re-concentrated by a lens, and an optical device applying a low density night time light or day time sun light and the like as a light source is newly developed.

And, a thermal collecting device for sun light can be constructed at various temperature from low temperature to high temperature region, and a concentrating type light generating device having a cooling device and a device for transferring the sun light to remote place such as underground room are developed.

Since the concentrating ratio can be increased,

a telescope capable of further more clearly magnifying and sensing a remote physical object than before can be constructed into two kinds of light path changing type or linear type, entire length of device including mirror tube is manufactured greatly shorter relative to the concentrating ratio, and an operating device construction directing an observing object is easy.

The spreading angle of the primary and secondary mirrors may be determined in accordance with manufacturable preciseness and using device.

And, the invention is equipped with sun light tracking device and telescope operating device, and concentrates and utilizes an artificial light being a kind of electromagnetic wave as well as natural light.

CLAIMS :

1. A concentrating optical system which is characterized in that a concentrating optical system of cross sectional structure corresponded with a parabolic type primary mirror spread to only one side of axis line and a constricted analogous figure secondary mirror co-owning a focus and axis line is constructed symmetrically to right and left and linearly and thereby concentrating in parallel a parallel incident light.

2. A concentrating optical system as defined in claim 1, which is characterized in that the primary mirror being spread in rim angle of less than 90 degrees and the secondary mirror orthogonally crossing with axis line are constructed, so that an incident light and a concentrated light are orthogonally crossed.

3. A concentrating optical system being linearly constructed in which a large and small parabolic type mirrors being symmetrically spread at a rim angle of less than 90 degrees are constructed so as to be confronted with co-owning a focus and an axis line, and a small secondary mirror projecting surface is opened at center portion of a large primary mirror and a concentrating light utilizing device is provided within a light path after the opening portion.

4. A concentrating optical system as defined in claim 1 or 3, which is characterized in that the first and second mirrors are constructed in circular structure.

5. A concentrating optical system defined in any of claims 1 to 4, which is characterized in that a flat plate type mirror is provided within a parallel concentrated light path whereby changing the concentrated light path.

6. In a concentrating optical system applying a sun light as a light source,

a sun light thermal collecting device which is characterized in that a tracking device is provided and a thermal collecting device is provided within a concentrated light path whereby tracking a sun and collecting a heat.

7. In a case that said thermal collecting device of claim 6 is linearly constructed,

a sun light thermal collecting device which is characterized in that a linear lens converging the concentrated light and an evacuated tube type thermal collecting tube receiving the converged light are provided, whereby cavity thermal collecting.

8. In a case that the mirror of the device of claim 6 is constructed in circular structure,

a cavity type thermal collecting device in which a parallel light converging lens is provided, a

thermal resistant light passing window is provided within a converged advancing light path, a thermal collecting tube having " ⊐ "-shaped cavity thermal collecting wall receiving the converged light is constructed, and a behind portion is formed by a vacuum insulation layer.

9. In a concentrating optical system which applies a sun light as a light source and linearly constructed,

a sun light generating device in which a sun cell module is provided within the concentrated light path, a cooling fluid conduit pipe is provided to its behind, and a tracking device is provided, whereby concentrating and generating.

10. In a concentrating optical system applying a sun light as a light source,

a sun light utilizing device in which a parallel concentrated light converging lens is provided, a light receiving light transferring media is provided, 2-axes tracking device is provided, whereby utilizing by lighting the sun light to remote place.

11. In a linearly constructed sun light collecting and utilizing device among claims 6, 9 or 10,

a sun light utilizing device in which a solar cell module is provided at an axis region below the focus from vertex of the primary mirror whereby light

generating by slantly incident light.

12. In a concentrating optical system constructed in circular structure applying the sun light as a light source,

a solar furnace device in which a refractive type re-concentrator converging the parallel concentrated light is provided, a melting pot is provided at its converging point, and 2-axes tracking device is provided.

13. In a case that the concentrating optical system is constructed in circular structure,

a telescope device in which a parallel concentrated light converging circular lens is provided, and an eye lens having same focus is constructed.

14. A sun light utilizing device as defined in claims 6, 9, 10, 12 or 13, in which a solar cell module is provided at peripheral portion of the primary mirror or at behind portion of the secondary mirror, whereby executing a light generation with doing a proper object function.

15. In a case that the concentrating optical system is constructed in circular structure,

a concentrated light utilizing device in which the concentrated light path is divided, different concentrated light utilizing target devices are provided at both sides, a flat plate mirror is

attached into a rotatably supporting annular structure receiving tube at its dividing point, a rotary type light changing device protruded with an operating handle portion is provided, whereby selectively constructing the light path.

16. A concentrated light utilizing device as defined in claim 15, in which the divided light paths are made to a tracking hollow axis, and a concentrated light utilizing target device is contained therein.

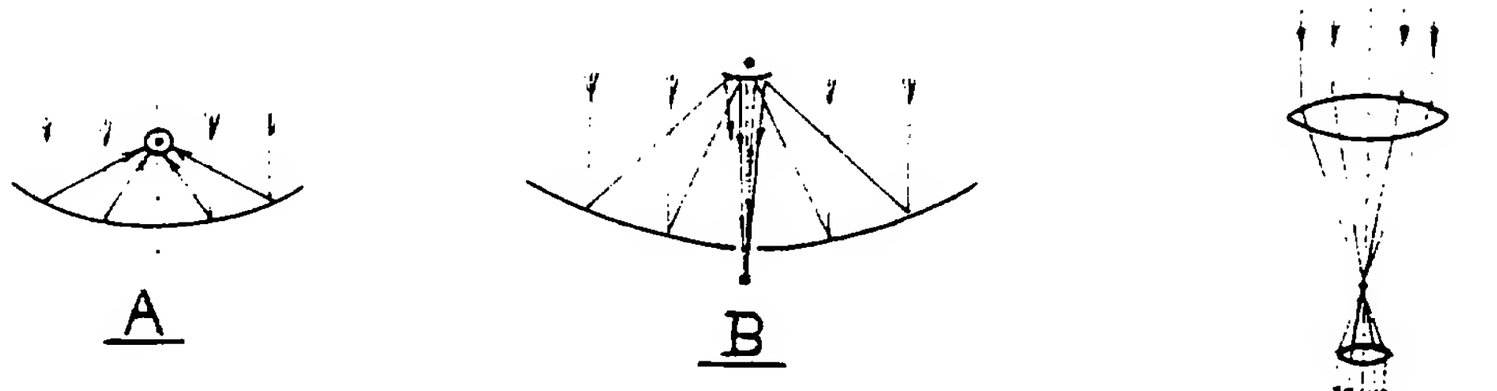

FIG. 1

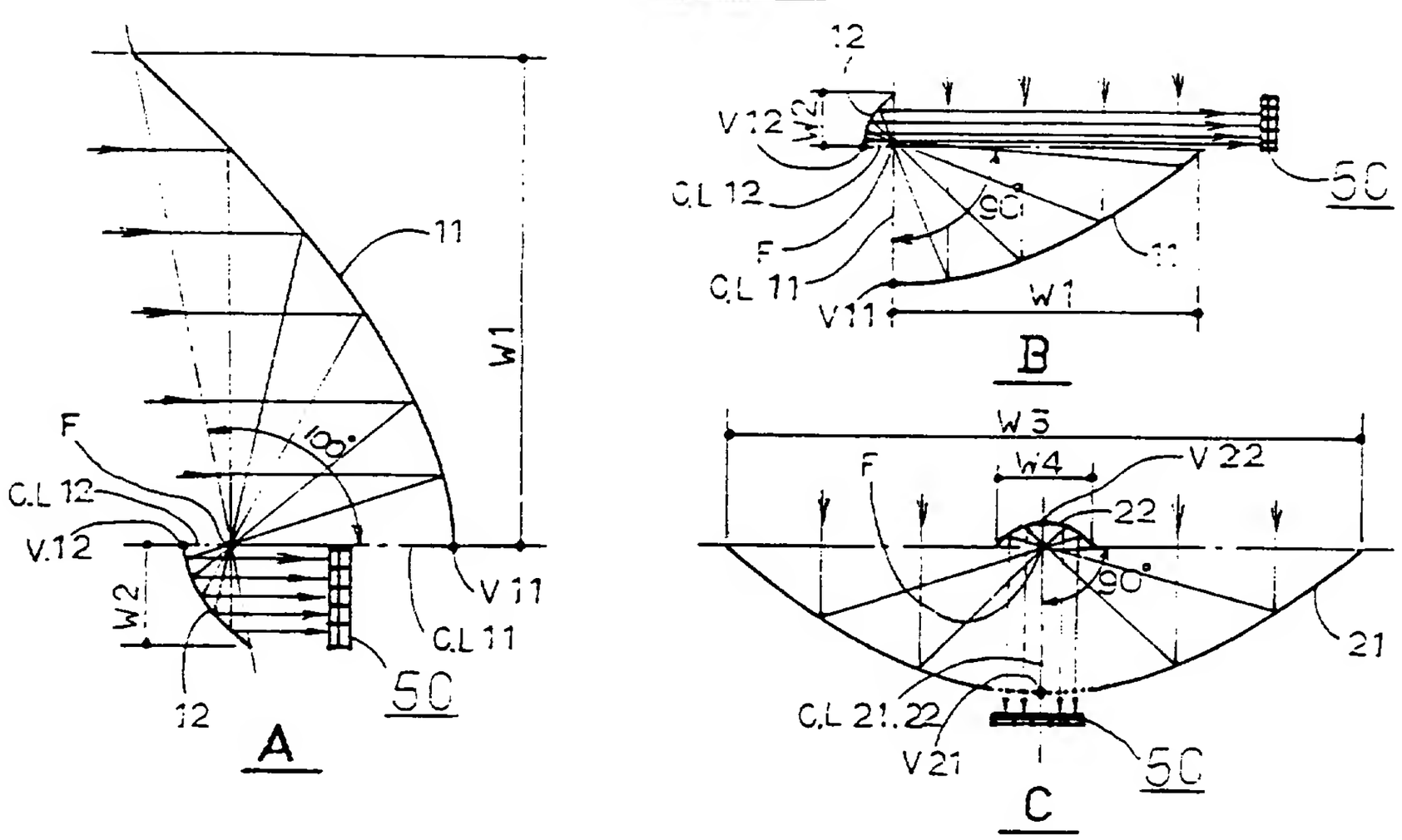

FIG. 2

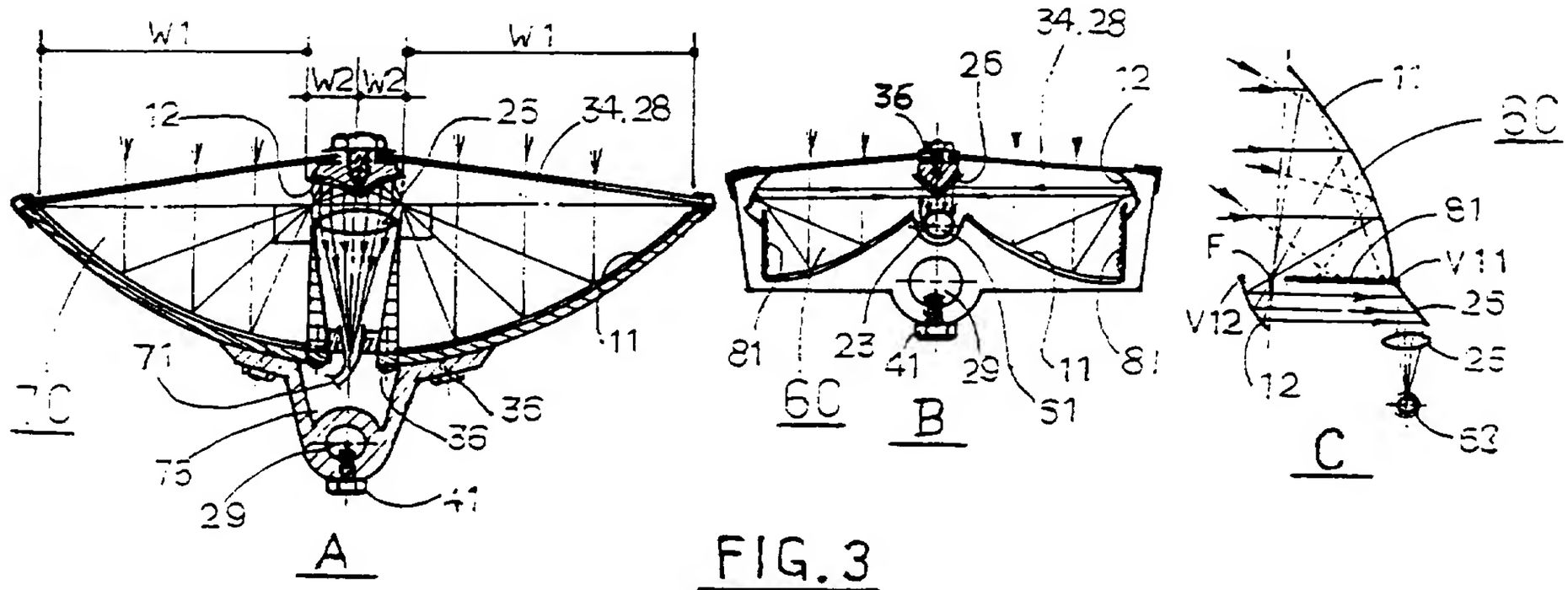

FIG. 3

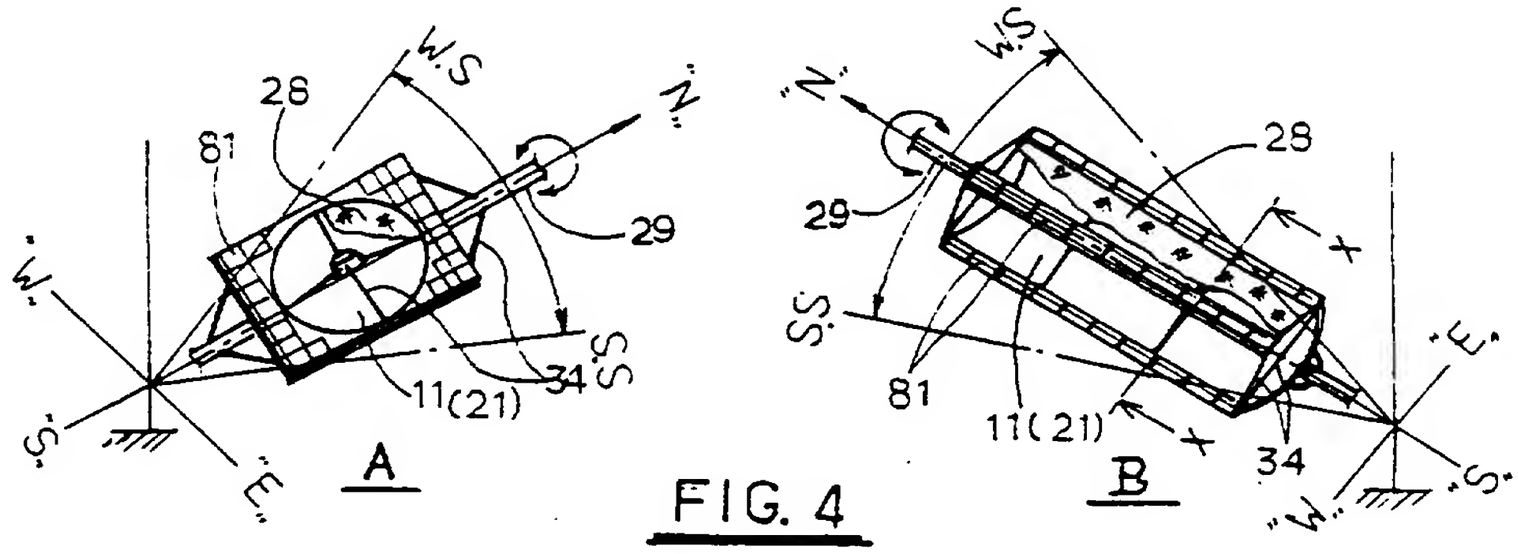

FIG. 4

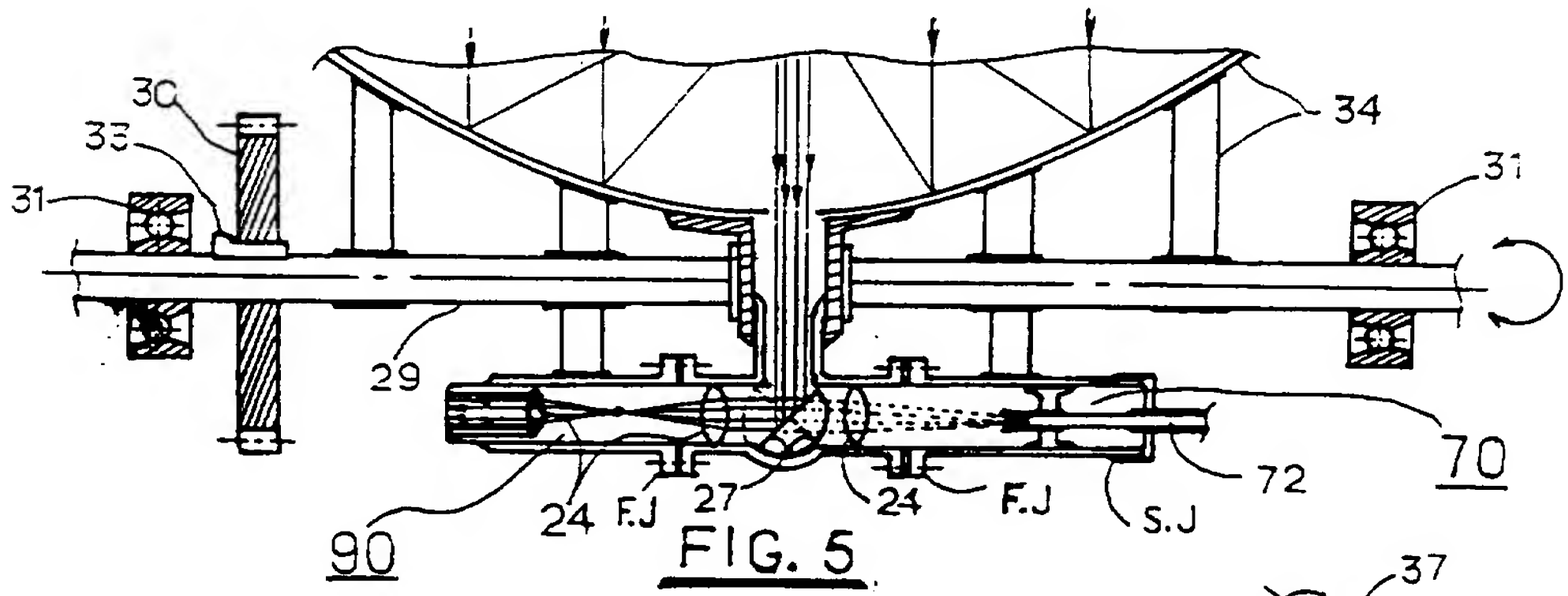

FIG. 5

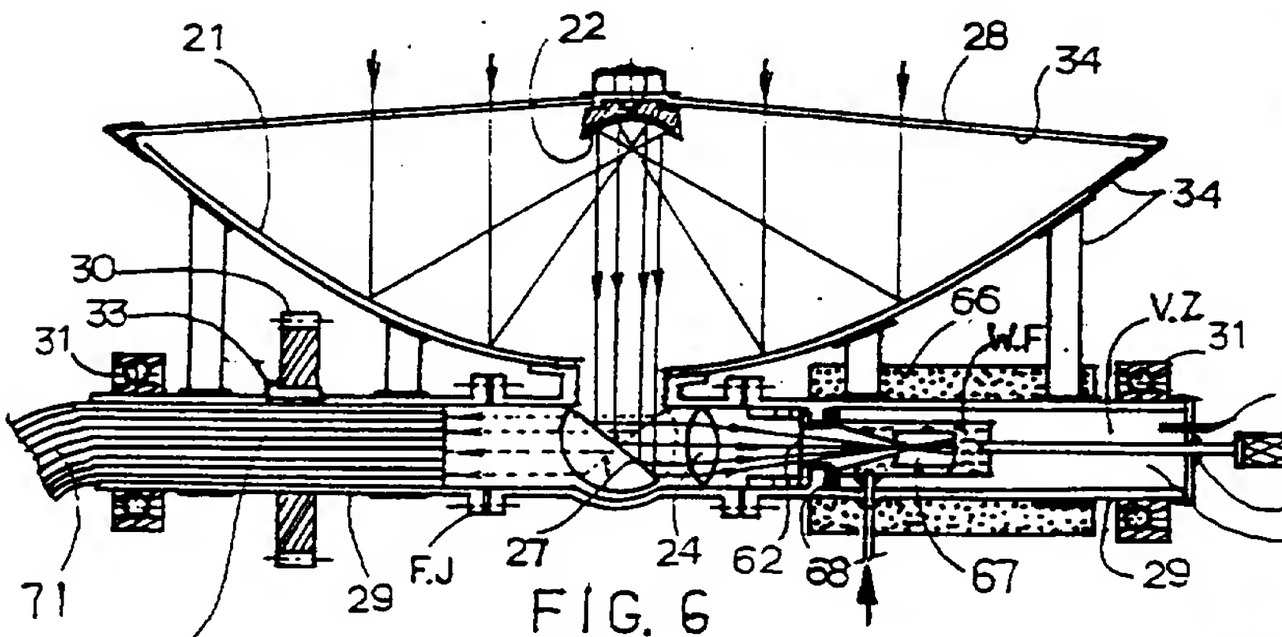

FIG. 6

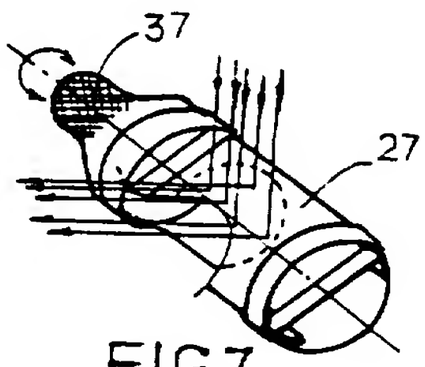

FIG.7

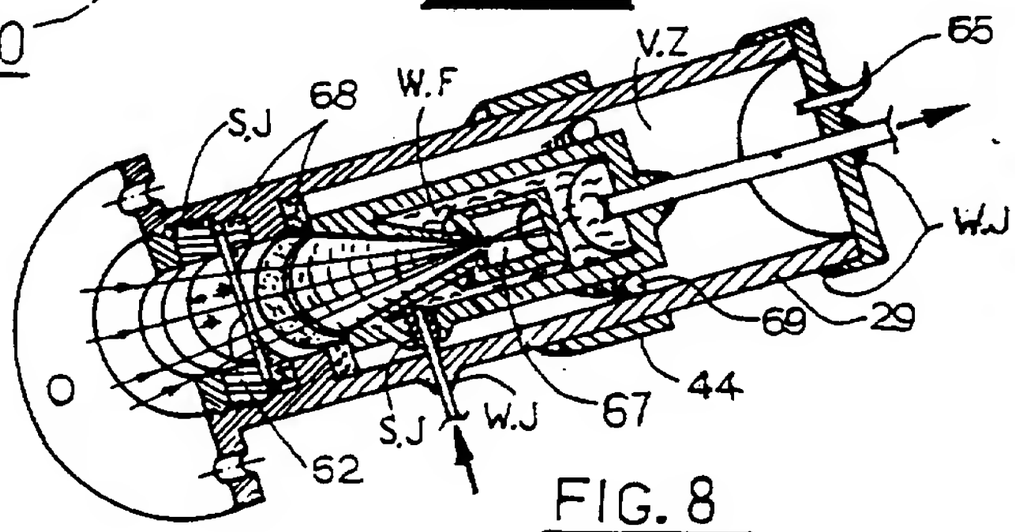

FIG. 8

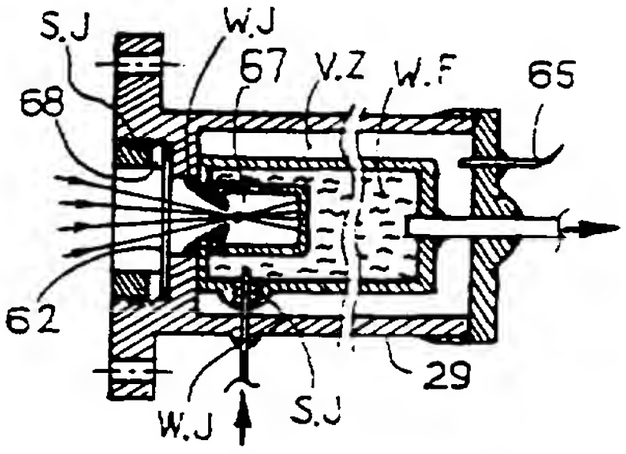

FIG. 9

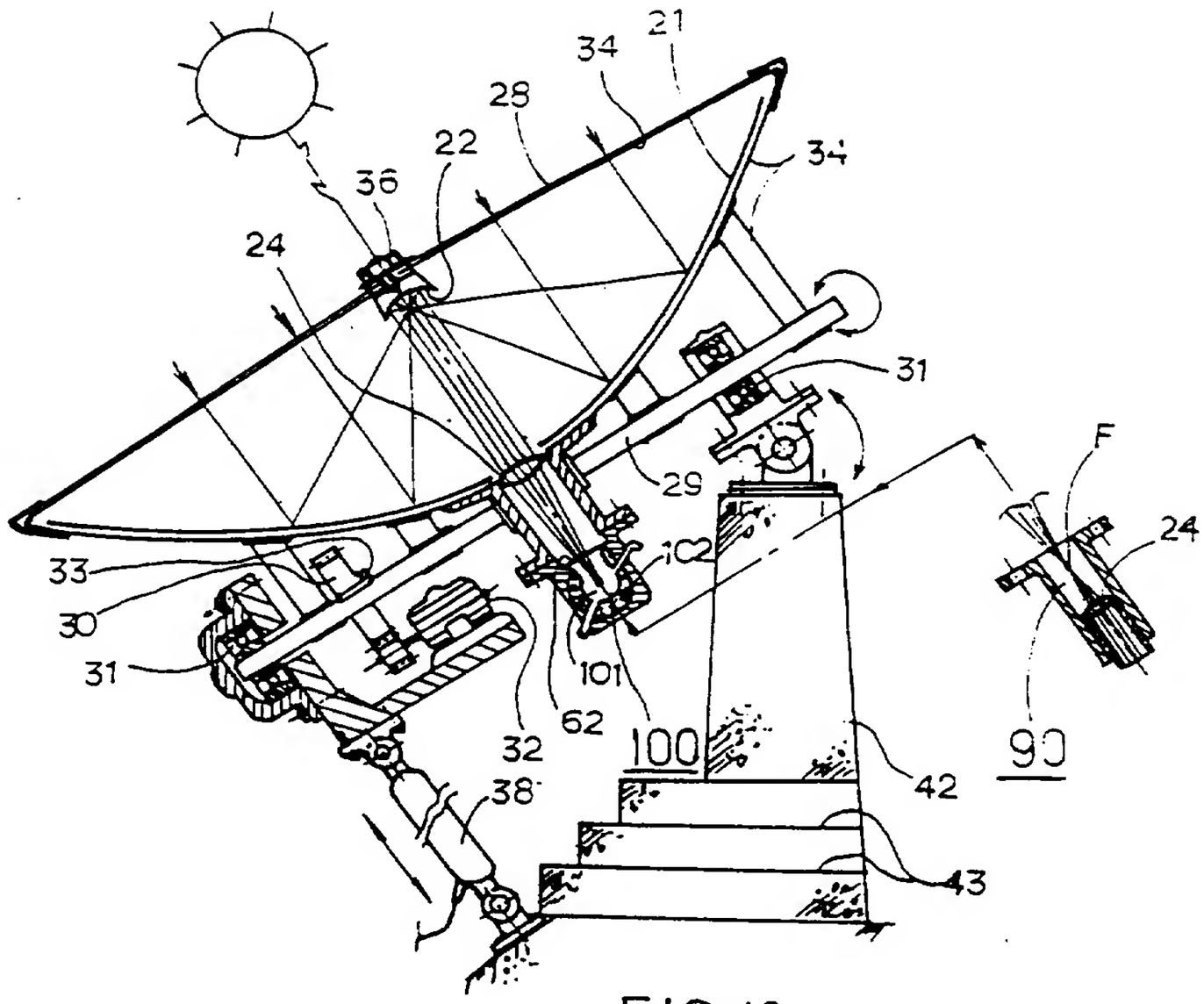

FIG. 10

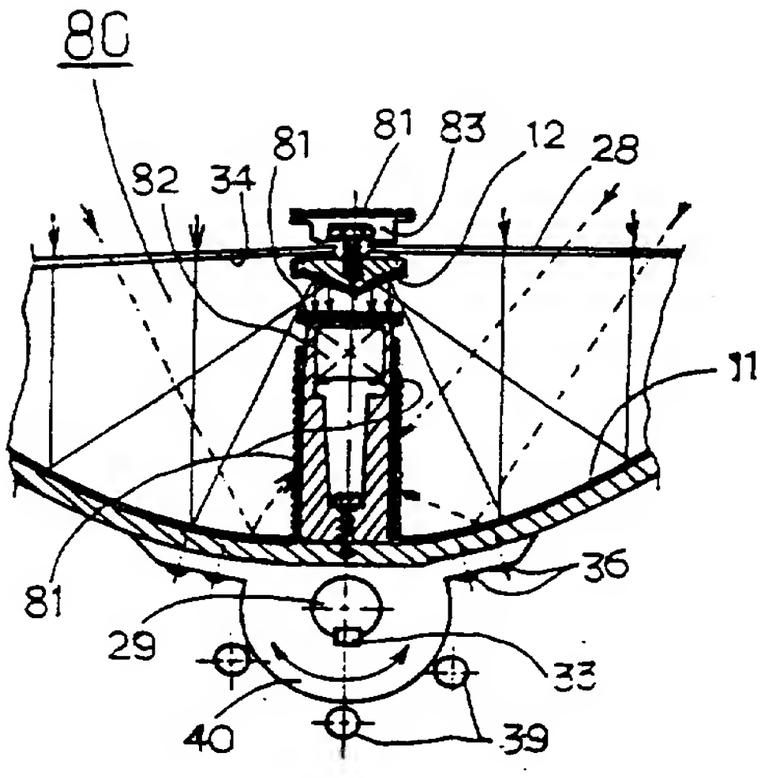

FIG. 11

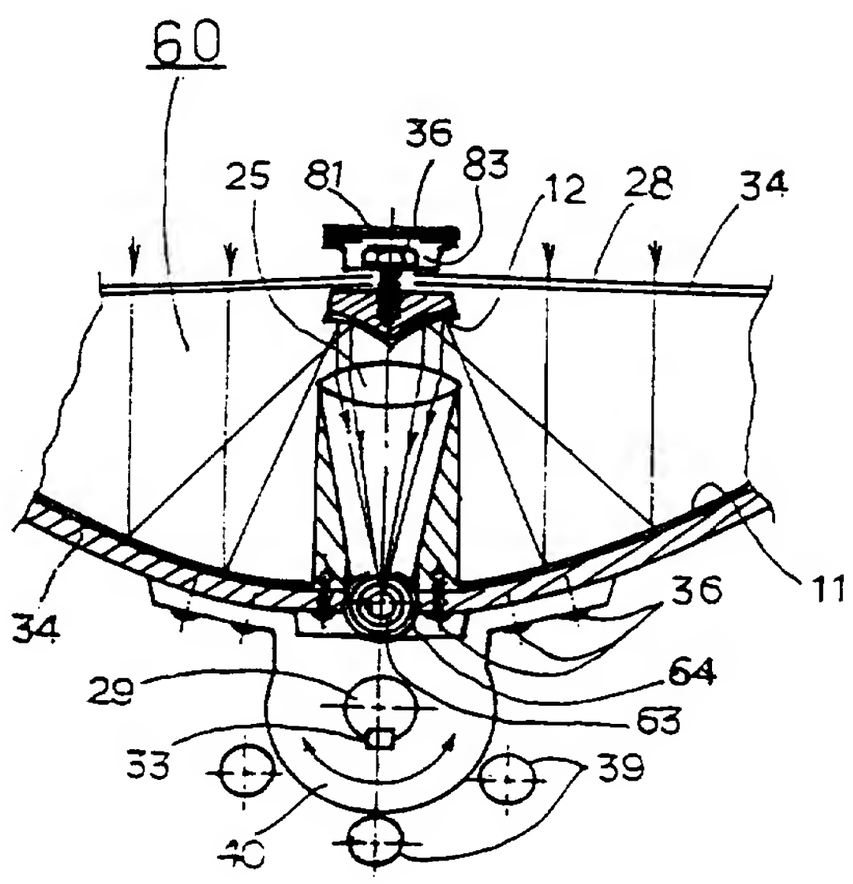

FIG. 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR 96/00167

A. CLASSIFICATION OF SUBJECT MATTER

IPC[6]: F 24 J 2/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC[6]: F 24 J 2/06,2/08,2/10,2/12,2/13,2/14,2/15,2/16,2/18; G 02 B 17/00,17/02, 17/06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 27 33 915 A1 (ORRISON) 08 February 1979 (08.02.79), claim 1; fig.2,5.	1
A	WO 80/00 489 A1 (ADVANCED SOLAR POWER COMPANY) 20 March 1980 (20.03.80), fig.1; abstract.	1
A	US 5 365 920 A (LECHNER) 22 November 1994 (22.11.94), fig.1.	1
A	Sviet Inventions Illustrated, Sections P,Q, Week E 29, 01 September 1982 (01.09.82), SU 862 625 A (AS UKR MAT TECH PRO) 25 September 1981 (25.09.81), fig..	1
A	GB 1 129 862 A (HINE) 09 October 1968 (09.10.68), claim 1; fig.3,4.	1,2,4

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
31 January 1997 (31.01.97)	07 February 1997 (07.02.97)
Name and mailing address of the ISA/ AT AUSTRIAN PATENT OFFICE Kohlmarkt 8-10 A-1014 Vienna Facsimile No. 1/53424/535	Authorized officer Holzweber Telephone No. 1/53424/461

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR 96/00167

Im Recherchenbericht angeführtes Patentdokument Patent document cited in search report Document de brevet cité dans le rapport de recherche	Datum der Veröffentlichung Publication date Date de publication	Mitglied(er) der Patentfamilie Patent family member(s) Membre(s) de la famille de brevets	Datum der Veröffentlichung Publication date Date de publication
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		ES T3 2076359	01-11-95
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		ZA A 9001525	30-01-91
SU A 862625		keine - none - rien	
GB A 1129862		keine - none - rien	

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TITLE: CONCENTRATING OPTICAL SYSTEM AND CONCENTRATED LIGHT UTILIZING APPARATUS

PUBN-DATE: April 10, 1997

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EUR-CL (EPC): F24J002/07 , F24J002/08 , F24J002/14 , F24J002/18

ABSTRACT:

CHG DATE=19990617 STATUS=O>A concentrating optical system in which semiparabolic type mirrors being spread to one side are constructed for use with primary concentrating and secondary concentrating, or a concentrating system for concentrating in parallel a large and small parabolic type mirrors (21, 22) confronting each other is constructed, so that the parallel concentrated light is heat collected, light collected or utilized for lighting, or else a refractive type converging concentrator is constructed whereby concentrating at high concentrating ratio. Since a light of wide range from not only high density but up to low density is tracked and concentrated, not only a solar furnace (50) but even telescope also are newly developed. A wide range concentrated light utilizing device is made in which not only natural light such as sun light and star light but also the light produced from artificial light source can be concentrated whereby utilized to industry.